CLAIMS

1. A method of completing a martensite-free brazing process with controlled pre- and post-brazing temperature and controlled temperature of a brazing free from detrimental structural changes and martensite formation, of a connecting piece (11) of electrically conductive material with a workpiece (12) of electrically conductive material, *characterised* in that the brazing process is divided by time into different phases both before, during and after the brazing-temperature phase in which the output of the process controlled by pulse duration modulation according to adjusted formulas is allowed to assume different determined constant or varying values controlling and regulating the instantaneous temperature in a braze joint and adjacent areas so that, in the phases of the pre-brazing temperature, an initial fast increase in temperature is produced which subsequently passes over to a levelling of the temperature curve in order to obtain a carefully determined brazing temperature, and during the phases of the post-brazing temperature, the temperature is successively lowered in order to submit the steel material to a controlled cooling at determined levels during determined time periods to allow for state transitions in the steel material. The process registers disturbances in real time and modifies and adapts the output formula to compensate for deviations from the desirable temperature curve during all phases. In case of instantaneous failures of the electric arc, the process initiates restart routines for re-ignition, and modifies the formula to compensate for time losses and fall in temperature. The process includes the operator selecting one of a number of different formulas adapted to different brazing situations, and the initial temperature of the workpiece (12) being taken into consideration at process start for modification of this formula. Process information and other data are collected, processed and stored for presentation at the desired moment, and comprises the basis for feedback, alarms, alarm-acknowledgement function, communications (35) and documentation by way of display (3) and external units including programming equipment for modification and complementing of the formula collection and computer programs. The process also encompasses brazing formulas adapted to brazing with equipment

and adapters (57) intended for the older type of pin brazing of different workpieces, connecting pieces, electrodes (55) and guard rings (56).

2. A device for the execution of the method according to Claim 1 for completing a martensite-free brazing process with controlled pre- and post-brazing temperature and controlled temperature of a brazing free from detrimental structural changes and martensite formation, of a connecting piece (11) of electrically conductive material with a workpiece (12) of electrically conductive material, *characterised* in that a power source (1) feeds the current to an electronics unit (2) where input data from different units are processed and where input data from the operator together with other input data determine one of a number of different formulas for the process output during the different phases of the brazing process, and when the power switch (8) is activated a carbon electrode (9) where only the surface area is petroleum-impregnated will short-circuit an electric circuit to a connecting piece (11) of electrically conductive material, preferably a cable shoe, and an electromagnet (65) in a brazing gun (7) will subsequently lift the hydraulically damped (64) lifting-speed-controlled carbon electrode (9) from the surface (25) of the connecting piece (11), the surface being geometrically prepared by knurling and/or blasting and provided with cavities, and an electric arc (26) will be ignited in the direction of the prepared surface (25) where local ridges and peaks have created electron or electron-hole concentrations, and will be maintained and, protected by gases emitted from the impregnated surface area of the carbon electrode (9), will work on the connecting piece (11). Material from the carbon electrode (9) is released during the brazing process and settles in a layer (27) on the prepared surface (25) of the connecting piece (11) in the immediate vicinity of the electric arc (26), where the bond strength, thickness and appearance of the layer (27) are affected by the preparation of the surface (25). Through an electrically conductive guard ring (21) the connecting piece (11) is given the opposite electric polarity in relation to the carbon electrode (9). The guard ring (21) is joined with the gun (7) by a gimballed gyro in such a way that incorrect angle of the gun (7) or an angular change of the gun (7) or the connecting piece (11) during the brazing process does

not interfere with the ring's (21) electric contact with, or processing of, the connecting piece (11) in order to obtain a shaping of the connecting piece (11) against the workpiece (12) and an evenly thick filler column. The guard ring (21), the ring holder (29) and the ring holder's (29) cylindrical portion (30), conical portion (31) and stop ledge (32) co-operate in such a way that the cylindrical portion (30) directs the insertion of, and prevents the guard ring (21) from assuming too great a tilt at mounting, while the conical portion (31) secures the guard ring (21) by pinching when the latter is inserted even if it is tilted by the operator. The parts together comprise a mechanical overheating protection which, at an excessive temperature, through the operator's pressure produces a shape transition (50) of the guard ring (21) so that it is pressed further into its seat (31), and consequently shortens the length of the electric arc (26) and reduces its resistance, which reduces its heat build-up directly through component-controlled, or indirectly through formula-controlled limitation of power. The stop ledge (32) limits the axial movement of the reshaped guard ring (21) in order to avoid too short an electric arc (26). The heat initially built up in the process is quickly absorbed by the geometrically prepared surface (25) of the connecting piece (11) since the surface-to-mass ratio is great, and initially raises the temperature of the connecting piece (11) quickly enough for disturbing oxide formation between the connecting piece (11) and the filler material (18) not to reach a significant level before these parts are joined. The heat built up will be transferred to a workpiece (12) through a flux and, during slower increase in temperature to intended brazing temperature, will join the workpiece (12), the connecting piece (11) and the filler material (18) in a braze joint, whereupon, in accordance with the set formula, the electric arc (25) is regulated so that the temperature of the work material (12) falls to a level where a possibly formed martensite structure during a certain time is transformed to another structure.

3. A device according to Claim 2, *characterised* in that the connecting piece's (11) geometrically prepared surface (25) is provided with one or several cavities (23) absorbing carbon material from the environment and act as anchoring points for the released carbon layer.

4. A device according to Claim 2, *characterised* in that the brazing clip (18) with two tabs (19) is partially secured by pinching sideways under the connecting piece (11).

5. A device according to Claim 2, *characterised* in that, by use of an adapter (57) inserted into the electrode holder (39) and appropriate formula, the older type of brazing process with metal electrode (55) can be realised as well.

6. A device according to Claim 2, *characterised* in that the carbon electrode's (9) surface area has been petroleum-impregnated whereas the short ends (22) have not been impregnated so that when the electric arc (26) is started, the temperature increases faster in the connecting piece's (11) surface (25) because no impregnator needs to be gasified from the end (22) of the electrode, and a better bond strength is consequently obtained between released carbon layer (27) and the connecting piece (11) by the higher temperature and absence of petroleum products on the surface (25) of the connecting piece (11).

7. A device according to Claim 2, *characterised* in that a protective boot (49) is applied between an axis (53) and the front end of the brazing gun (7).